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Effects of fermented clupeid paste as a substitute for fish meal in the diet of *Clarias gariepinus* fingerlings in hapa nets

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Abstract

An experiment was conducted to determine the effects of fermented clupeid paste as a substitute for fishmeal in the diet of Clarias gariepinus fingerlings in hapa nets. Five (5) diets (40% crude protein) containing fishmeal substituted with 0 % (control), 25%, 50%, 75%, and 100% fermented clupeid paste were formulated. The fish fingerlings of mean weight of 10.83±0.37g were fed to satiation at 5% body weight twice per day for 30 days in hapa nets. It was observed at the end of the feeding trial that fish fed with 50% fermented clupeid paste along with 50% fish meal gave the highest final weight (FW = 19.29g),, mean weight gain (MWG =8.47g), daily growth rate (DGR =0.28g/day), specific growth rate (SGR 1.92%/day) and total fish production (TFP) of 1.93kg/m³ . The feed conversion ratio of 1.42 was best in Diet 1 (Control). Growth was significantly affected (P<0.05) and total fish production (TFP) among the treatments. Based on the results obtained from this experiment, 50% substitution level of fermented clupeid paste with fish meal is considered the optimum inclusion level for the growth of African mud catfish, C. gariepinus fingerlings production in hapa nets.

Keywords: fermented clupeid paste, growth and nutrient utilization, African mud catfish, C. gariepinus, hapa nets.

Introduction

Fish production through fish culture is on the increase in Nigeria. Among the problems of the sector is lack of nutritionally balanced and low-cost feeds (Falaye, 1992). Fish feed accounts for about 60-70% of the variable cost in fish culture. This is due to high cost of feed ingredients especially Fish meal which is the conventional source of dietary protein in fish and livestock feeds. Fish meal is used extensively as a source of fish protein in feed because of its unrivalled nutritive value. Compared with other commercially used protein sources fish meal has high biological value, higher in digestible energy, rich in available lysine, methionine, minerals, vitamins and unidentified growth factors required by fish (Lovell, 1989). Although fish meal has been recognized as the best source of animal protein for most fish species, it is relatively expensive. In view of the scarcity and escalating costs of most conventional animal feed ingredients, it has become necessary to search for cheaper alternative nutrient sources to enhance fish culture development. Efforts geared towards substituting fish meal with cheaper substitutes have yielded positive results. Some industrial by-products, wastes and some under-utilized crops used as fish meal substitute in fish and livestock feed production include maggot (Ugwumba and Abumoye, 1988), Cotton seed cake (Eyo, 2001), Duckweed (Mbagwu and Okoye, 1988), pawpaw leaf meals (Reyes and Fermin 2003), Jackbean (Alegbeleye et al., 2001) and brewers waste (Adikwu, 1991) among others.

Fish meal remains the most expensive ingredient in aquaculture feeds and fish farmers now seek its replacement with less expensive alternative protein feedstuffs. One of such alternatives is fish paste prepared from whole fish; fishery wastes by-products or fish farm mortalities (Lo et al., 1993). Fish paste is prepared either by mineral and/or organic acid preservation (acid silage) or by anaerobic microbial fermentation (fermented fish paste). The latter is preferred in developing countries because it is cheaper to produce, involves simple artisanal technology which is adaptable at cottage level and possesses good storage properties (Dong et al., 1993). As fish paste is slurry, it is bulky and difficult to transport, stir or store; hence it has to be dried mixed with other dry ingredients or filler material. Several methods of removing or reducing the water content of fish silages include Sun drying, kiln drying, spray drying, vacuum evaporation, drum drying or CO-drying (Disney et al., 1978).

The experiment is designed to evaluate the effects of fermented clupeid paste as protein source (partially replacing fish meal) on growth performance, feed conversion and protein utilization in dry diets for fingerlings of the African mud catfish, *C. gariepinus*.

Materials and Methods

- **Experimental site**. The experiment was carried out in Federal College of Freshwater Fisheries Technology, New Bussa fishpond with dimension of 756m^2. Pond preparation was done to make sure that unwanted weeds both inside and outside the pond were manually removed. The source of water to the pond is through rainfall, underground seepage and borehole.
- **Experimental fish.** Five hundred (500) fingerlings of *C. gariepinus* of mean average weight of 10.83± 0.37g were obtained from a reputable hatchery complex at Ijebu Ode, Ogun State. The fish were acclimatized for three (3) days in a hapa of mosquito mesh size. During the acclimatization the fish were not fed with any form of feed, this was done to empty their gastrointestinal tract and prepare them for the new diet.
- **Experimental design.** Ten (10) hapa nets of L X B X H: 1m x 1m x 1m were used for the experiment. They were properly washed, disinfected and allowed to dry for a day. The hapa nets were mounted across the pond from one end of the pond to the other with the aid of number eight (8) Kuralon rope on pegs. The hapa nets were tied firmly to the Kuralon rope so that half of the nets were submerged into the pond water. Sinkers were tied at the lower edges of the hapa nets to help spread and balance the nets. The hapa nets have an opening at the top where stocking, feeding and sampling of the experimental fish were done. The opening is kept closed with a clip after every feeding and sampling. The design consists of five (5) treatments replicated twice in a completely randomized design. Fifty (50) fingerlings of *C. gariepinus* of equal size were stocked in each hapa nets. The fish were weighed with an electric sensitive weighing balance (OHAUS – LS -200 Models).
- **Fermentation procedure of the fish paste.** Fermented fish paste was prepared from clupeid mixed with 20% salt and pounded for even distribution of the salt. The mixture was packed into an air tight plastic container sealed with paper tape and buried in a 4ft hole for a period of one month for fermentation to take place. The slurry was then oven dried and used as fermented fish paste.
- **Preparation of experimental diets.** The feedstuffs used in compounding the experimental diets were fermented Clupeids paste, fish meal, guinea corn, yellow maize, vegetable oil, bone meal, vitamin premix and lysine. The various feedstuffs were thoroughly mixed together in a bowl. The resulting mixture was made into a dough and pelleted with College improvised domestic Pelleting machine and then sun-dried for 12 hours. The feed was packaged in air-tight polythene bags at room temperature and labeled.
- **Feeding and sampling methods**. The pelleted feed was initially ground and fed to the fish fingerlings at 5% of their body weight. The fish were fed with the experimental feed twice daily using half of the daily ratio in the morning (between 7.00am – 8.00am) and the other half in the evening (between 5.00pm–6.00pm). Sampling was carried out weekly to determine the increase in their body weight. The new feeding rate for each hapa net was determined depending on their new body weight. The experiment lasted for four weeks. Experimental feeds were analyzed according to the method of AOAC (1990).
- **Water quality parameters.** Water quality parameter was monitored at regular interval. Water temperature, and dissolved oxygen (DO) concentration was determined weekly using Brannan thermometer and digital oxygen probe meter. The pH was monitored weekly using a pH meters.

Results and Discussion

Effects of different levels of fermented clupeid paste were examined on the growth and nutrient utilization of *Clarias gariepinus* fingerlings in hapa nets for 30 days. All tested diets were accepted and actively fed upon by the fish while no pathological symptoms resulting from nutritional deficiency was observed among all fish used for the experimental diets. The growth and nutrient utilization of African mud catfish (*Clarias gariepinus*) fed fermented clupeids paste based diets in hapa nets for four weeks is presented in Table 2. There was an increase in mean weight gain as the amount of fermented clupeids meal increased from 0% (Diet1) to 75% (Diet 4) with the highest weight gain by fish fed diet 3.

Table 1: Percentage composition (g/100 g dry weight) of the experimental diets for *C. gariepinus* fingerlings and the proximate analysis

Feed ingredients	DT1 (0% FCP)	DT2 (25% FCP)	DT3 (50% FCP)	DT4 (75% FCP)	DT5 (100% FCP)
Fermented Clupeids paste	0.00	13.50	27.00	40.50	54.00
Fish meal	54.00	40.50	27.00	13.50	0.00
Guinea corn meal	30.00	30.00	30.00	30.00	30.00
Yellow maize meal	10.00	10.00	10.00	10.00	10.00
Vegetable oil	2.00	2.00	2.00	2.00	2.00
Bone meal	1.00	1.00	1.00	1.00	1.00
Vitamin premix	1.00	1.00	1.00	1.00	1.00
Lysine	2.00	2.00	2.00	2.00	2.00
Chemical composition					
Moisture content (%)	10.85	12.75	12.86	11.33	11.28
Crude protein (%)	39.30	37.92	36.43	34.95	33.46

Feed ingredients	DT1 (0% FCP)	DT2 (25% FCP)	DT3 (50% FCP)	DT4 (75% FCP)	DT5 (100% FCP)
Crude fat (%)	10.22	10.48	10.61	10.80	10.92
Crude Ash (%)	5.62	4.28	4.33	4.40	4.48
Crude fiber (%)	8.23	10.25	10.32	10.39	10.48
NFE	36.03	34.84	36.06	38.93	40.30

NFE: Nitrogen free extract

The results revealed that there was a decrease in protein content as the inclusion level of the fermented clupeids meal increased in the diets. Diet 1 (control) with 0% fermented clupeids meal had the highest crude protein content of 39.30%, followed by Diet 2 with 25% fermented clupeids meal (37.92%) and the least was Diet 5 with 100% fermented clupeids meal (33.46%).

Table 2: Growth and nutrient utilization of *C. gariepinus* fingerlings fed different levels of fermented clupeids based diets for four (4) weeks.

Parameters	Treatments				
	1 (0%)	2 (25%)	3 (50%)	4 (75%)	5 (100%)
Initial Weight (g)	10.83^{a}	10.83^{a}	10.82^{a}	10.82^{a}	10.83^{a}
Final Weight (g)	17.36^{c}	17.39^{c}	19.29^{a}	18.46^{b}	16.12^{d}
Weight gain (g)	6.53^{c}	6.56^{c}	8.47^{a}	7.64^{b}	5.29^{d}
Daily growth rate (g/day)	0.22^{c}	0.22^{c}	0.28^{a}	0.25^{b}	0.18^{d}
Relative weight gain (%)	60.30^{c}	60.57^{c}	78.28^{a}	70.61^{b}	48.85^{d}
Food intake (g)	11.37^{b}	11.58^{b}	11.71^{b}	12.01^{a}	12.38^{a}
Specific growth rate (%/day)	1.57^{c}	1.58^{c}	1.92^{a}	1.78^{b}	1.33^{d}
Food conversion ratio (FCR)	1.74^{b}	1.76^{b}	1.38^{d}	1.57^{c}	2.34^{a}
Survival rate (%)	95	100	100	100	90
Total fish production (kg/m3)	1.65^{c}	1.74^{c}	1.93^{a}	1.85^{b}	1.45^{d}

Mean values within row with the same superscript are not significantly different (P>0.05).

The fish fed 50% fermented clupeids meal along with 50% fish meal in Treatment 3 were observed to have best final weight of 19.29g, best weight gain of 8.47g best specific growth rate of 1.07% per day, highest daily growth rate of 0.28g per day, highest fish production of 1.93kg/m^3 and best food conversion ratio of 1.38. The survival rate varied from 90% to 100%. The highest mean survival rate of 100% were recorded under Treatments 2, 3 and 4 (25% FCM: 75FM, 50% FCM: 50%FM and 75% FCM: 25FM) while the least of 90% was recorded in Treatment 5 (100% FCM along with 0%FM). The second best performance was recorded for fish fed 75% fermented clupeid meal along with 25% fish meal treatment having final weight of 18.46g, daily growth rate of 0.25g/day food conversion ratio of 5.46 and total fish production of 1.85kg/m^3 . The fish fed with 100% FCM along with 0% FM gave the least growth performance with final weight of 16.12g daily growth rate of 0.18g/day, FCR of 2.34 and lowest total fish production of 1.45kg/m^3. Water quality during the study showed mean temperature of 29.5°C, mean dissolved oxygen of 6.7mg/l, pH value of 7.4 and conductivity value of 220 μmhos/cm^3.

Growth response and feed conversion. The fermented clupeid based-diets did not pose any problem to *C. gariepinus* because all the fish among the treatments increases in weight. Water stability of all diets was suitable for fast and competitive feeders such as *C. gariepinus* as it ensured optimum feed uptake before disintegration of pellets. High fish survival was attributable to conductive water quality conditions in the experimental systems. Growth responses by fish in all fermented clupeid based-diets compared favourably with the control treatment which suggests that fermented clupeid based-diets could replace fish meal as dietary protein in dry diets for *C. gariepinus*. This agrees with reports that high levels of fish meal replacements by acid or fermented silage was accepted and gave good growth responses in *O. niloticus* (Phromkunthong and Chetanon, 1987) and *C. batrachus* and *C. macrocephalus* (Wee et al., 1986; Edwards et al., 1987). Lower growth responses by fish fed the fermented clupeid based-diets were probably caused by reduced palatability of diets, hence resulting in reduced feed intake.

Recommendation and Conclusion

The use of 50% fermented clupeid paste along with 50% fish meal is highly recommended for *C. gariepinus* fingerling production in hapa nets as a cheap effective alternative to the use of expensive and scarce conventional fish feed ingredients. Therefore, complete replacement of fish meal by fermented clupeid paste decreases growth rates and should not be used in *C. gariepinus* fingerling diets.

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